Space Weather Technical Forecast

Issued on Monday 3 March 2025 at 12:13 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/G2 late Tuesday 04 March and through UTC midweek. Chance of active 24-hour electron fluence beforehand

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 and 18 has been Low, with a peak flare of C2.4 at 02/2105UTC from a small, but rapidly developing sunspot region in the southeast quadrant.

The solar disc now features around five sunspot regions, with many of the smaller regions fading in the past 24 hours. Two of the remaining regions have seen some increase in complexity in the past UTC day. Most notably being AR4007, which is now the largest region on the disc and has seen significant penumbral growth, spreading and consolidation, along with a small Mt Wilson delta spot develop in its trailing region. AR4012 in the southeast has also seen some development and is is now the second largest spot on the disc, with the emergence of several new spots in recent hours. AR4009 now appears relatively stable after some strong growth in its northern set of spots, which may yet constitute a distinct sunspot group. AR4006 and AR4011 now represent the smallest and simplest spots on the disc, with little recent change.

No Earth-directed Coronal Mass Ejections (CMEs) were identified in available coronagraph imagery in the period.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, are indicative of a continuing waning connection to a strong positive polarity coronal hole fast wind (CH19/+).

Solar wind speeds have been on a declining trend, gradually waning from elevated levels near 500km/s to end the 24 hours at Slightly Elevated levels near 450km/s. The solar wind density was within typical single-figures ppcc throughout. The IMF was at Background levels on a slightly rising trend to a peak of 9nT, while the north-south component favoured a positive direction, but ranged from +7/-5nT. The phi angle was largely positive (away from the Sun).

The net result of the above solar wind measures was Quiet geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background levels.

High energy electron flux saw a relative rise in its diurnal oscillation relative to earlier in the UTC weekend, with a peak of High flux and 1460pfu reached at 02/1715UTC. The 24-hour fluence was

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below the Active threshold (1e8 integrated pfu), but on a rising trend, recording 4.57e7 integrated pfu at 02/2359UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries a daily Chance of becoming Moderate, with isolated M-class flares. This may rise slightly over the next few days as regions potentially return over the eastern limb.

Solar Wind / Geomagnetic Activity: A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/1900UTC. This is the only CME in the forecast.

Otherwise, fast wind influence from CH19/+ is expected to continue to wane, with Slightly Elevated winds soon easing to Background prior to any CME arrival. This is the only coronal hole in the forecast.

Geomagnetic activity is expected to be mostly Quiet initially until later Tuesday 04 March, whereupon the aforementioned CME may bring a Chance of G1 to end this UTC day and on through midweek UTC. Activity should lessen once again later in the UTC working week.

Energetic Particles / Solar Radiation: High energy proton flux should remain at Background levels.

High energy electron flux has seen diurnal rises into the high levels in the past 24 hours, which is expected to continue into the 04-05 March.. Consequently the associated 24-hour fluence has the potential to continue to rise, with a chance breaching the Active (1e8 integrated pfu) threshold by Tuesday 04 March. The 01/1730UTC CME reduces confidence after midweek UTC, with perhaps a Chance of Active fluence surviving should the CME miss or prove limited in effects.

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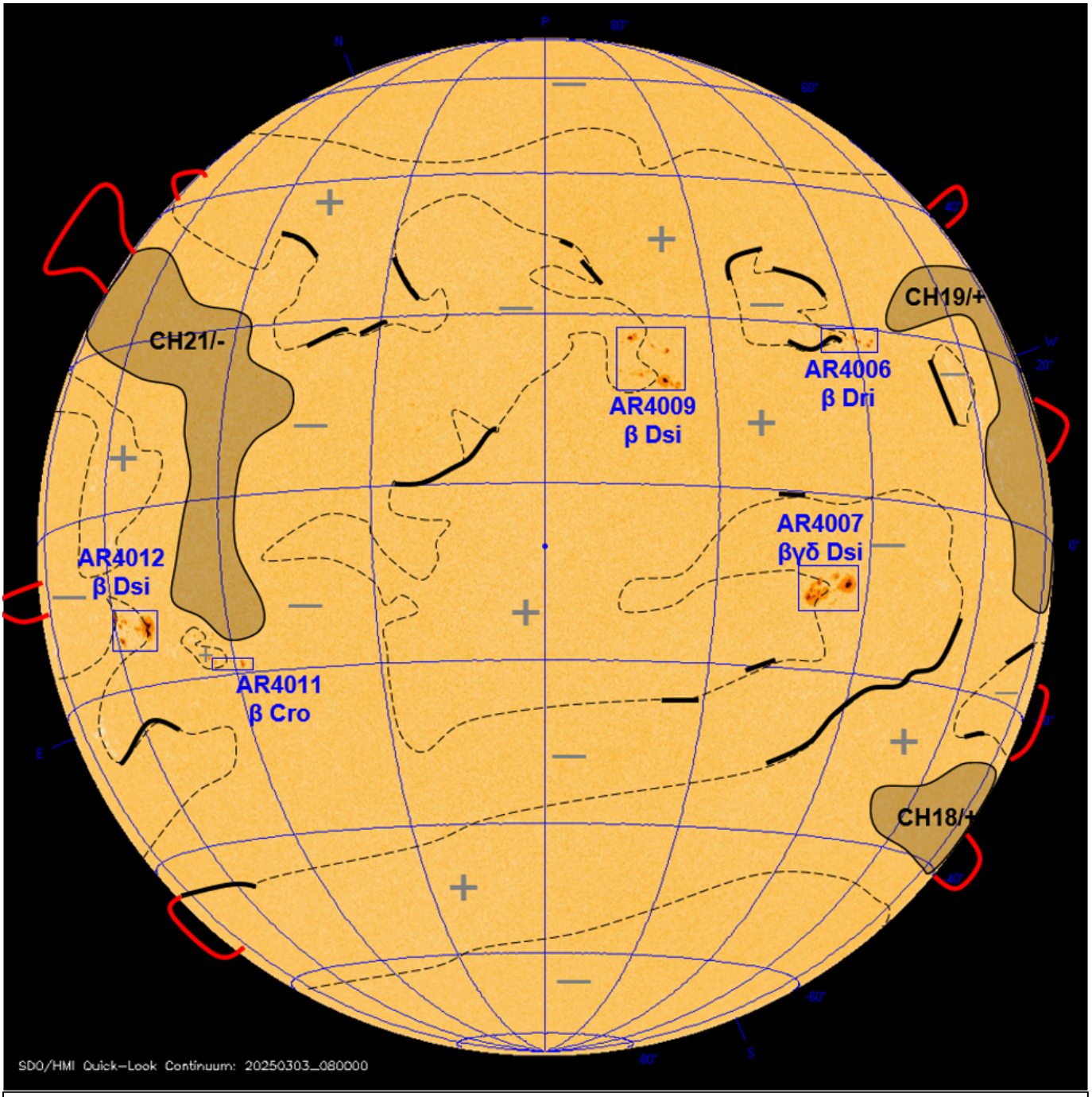
Figure 1: Solar synoptic map valid 03/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/1900UTC, although it appears the majority of the ejecta is south and east of the Sun-Earth line. This is the only CME in the forecast.

In addition to the above, the otherwise ongoing fast wind influence from CH19/+ is expected to continue to wane, with currently Slightly Elevated winds further falling to Background in the coming 24 hours or so. No further coronal holes are expected to feature in the forecast period.

Geomagnetic activity is now Likely to be mostly Quiet until later on Tuesday 04 March, whereupon the aforementioned CME brings a Chance of G1 (Kp5) to end this UTC day and on through midweek UTC. There is a Slight Chance this may reach G2 (Kp6) given the nature of the eruption, should it arrive early in the evening with unfavourable polarity. Because of the forecast arrival time coming late in the 24-hour UTC day, much of the G1 risk is actually post-dated into Wednesday 05 March in the magnetic cloud, although this may not fully develop due to the glancing incidence expected.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	30	40	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
02/0154UTC	Partial?	Filament eruption	SE quadrant	550	Late UTC day Tuesday 04 March, around 04/1900UTC.	Potentially protracted but marginal effects on passage given glancing incidence.

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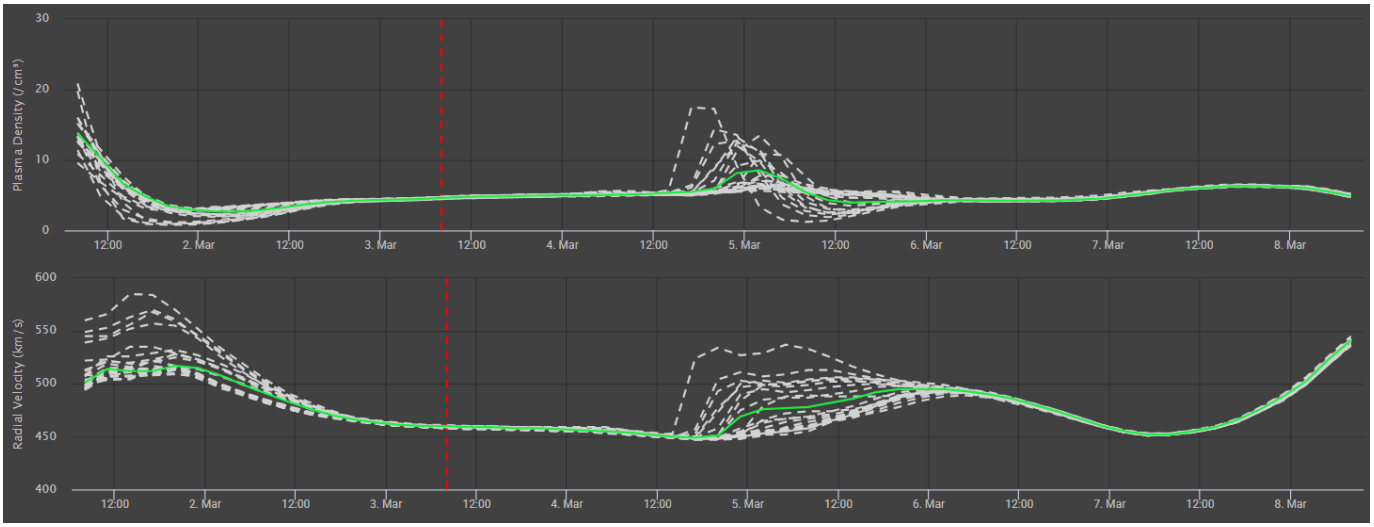
Figure 2: Latest MOSWOC ENLIL ensembles showing CME influence from later on the 04 March



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Radio Blackouts - X-Ray Flares

Solar activity has been Low, with occasional low level C-class flares.

The solar disc now features around five sunspot regions, with many of the smaller regions fading in the past 24 hours. Two of the remaining regions have seen some increase in complexity in the past UTC day. Most notably being AR4007, which is now the largest region on the disc and has seen significant penumbral growth, spreading and consolidation, along with a small Mt Wilson delta spot develop in its trailing region. AR4012 in the southeast has also seen some development and is is now the second largest spot on the disc, with the emergence of several new spots in recent hours. AR4009 now appears relatively stable after some strong growth in its northern set of spots, which may yet constitute a distinct sunspot group. AR4006 and AR4011 now represent the smallest and simplest spots on the disc, with little recent change.

In terms of the evolution of the forecast, no significant regions leave the disc in the period, while there are up to three returning Carrington locations of regions are due over the eastern limb into the next few days.

Overall, there is a slightly rising Chance of M-class flares in the period, near the raw value for the disc as it stands.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	No	30	40	40	40
Very Active	**R3-R5 (X Class)**	No	1	1	1	1

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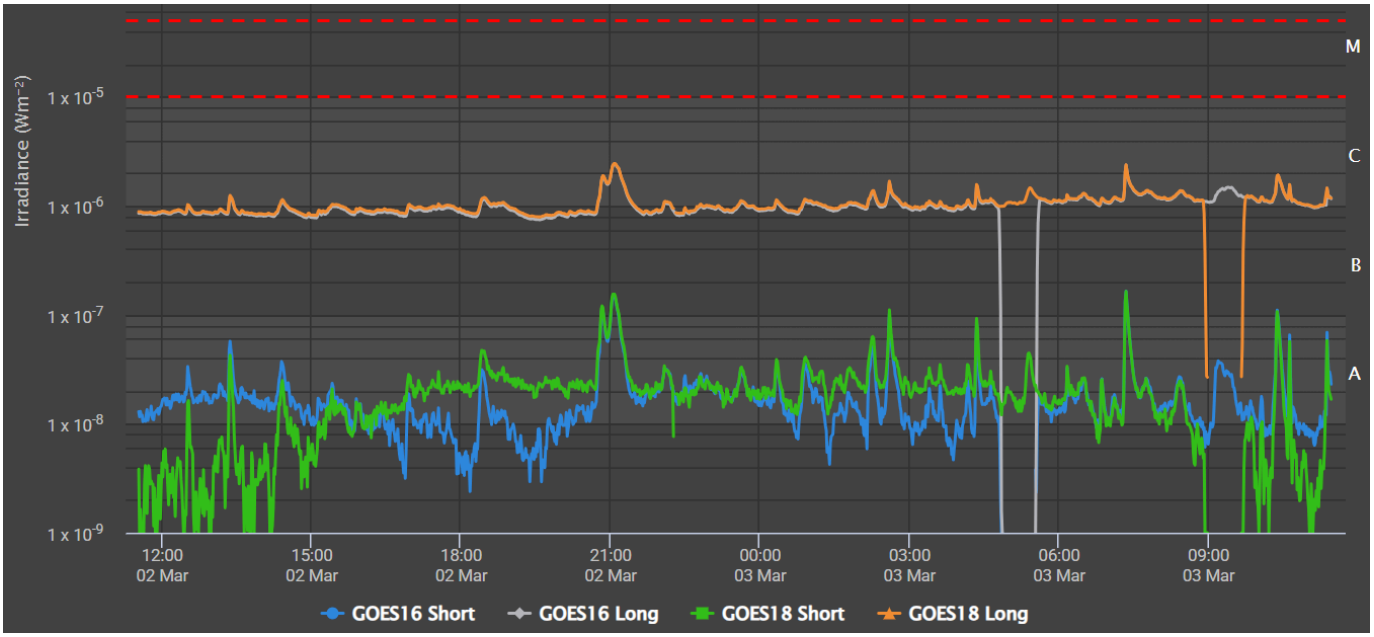
Figure 3: GOES16/18 X-ray flux



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is at Background, and expected to remain at this level. There is a Slight Chance of enhancement to S1 given any significant eruption from the sunspot regions currently on the Earth-facing disc, very gradually increasing through midweek UTC as some of the more complex regions reach better-connecting parts of the disc (i.e. the westernmost third).

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES16, has seen the magnitude of its diurnal oscillation rise over the past UTC weekend, reaching High flux for a period in the past UTC day. This was due to the recent charging of the outer Van Allen Belt from the fast wind enhancement from CH18/+ and/or CH19/+. This rising trend is expected to continue through until Tuesday 04 March, in a reaction to the recent Strong solar wind. High flux being maintained at GEO becomes far less certain through midweek UTC as a result of possible influence of the 01/1730UTC filament CME, which may cause electron redistribution and falls of flux at GEO.

The associated 24-hour fluence should see a rising trend initially, with a chance of rising above the Active level late Monday 03 or into Tuesday 04 March. MOSWOC REFM's recent thoughts in a strong surge to perhaps reach Very Active fluence has eroded in the past 24 hours, such that more recent data points are much more marginal as to whether Active fluence is even reached. This is before any fluence trend is polluted by potential CME influence and confidence is overall reduced. The chances of Active fluence persisting through midweek then rely on any CME missing Earth, else a very gradual erosion of GEO electron counts might be expected in the coronal hole-free forecast period.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	40	40	30	30
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: Electron Flux showing recent dirunal high levels

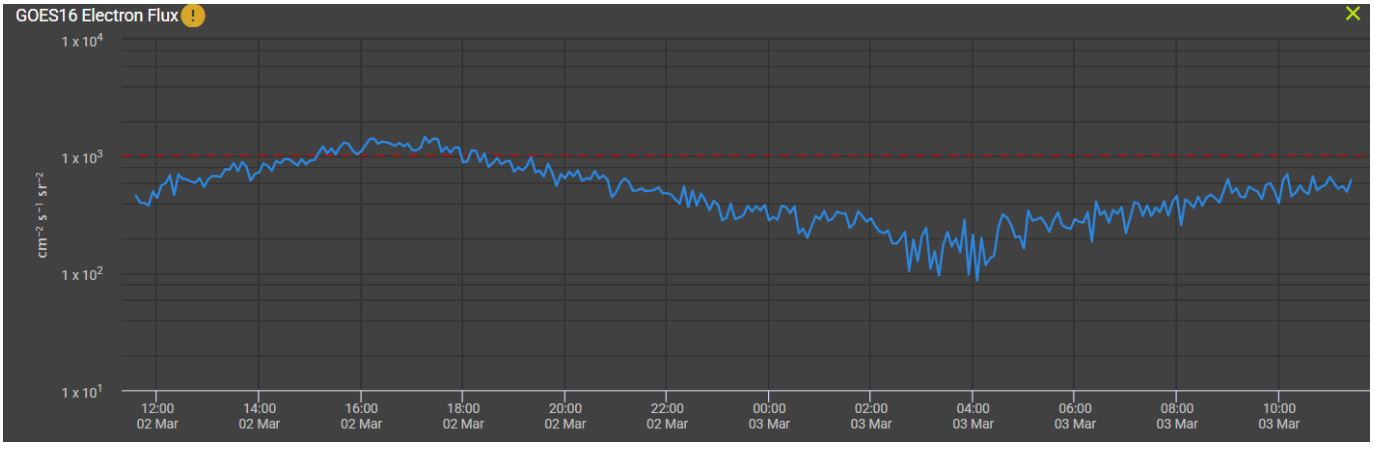

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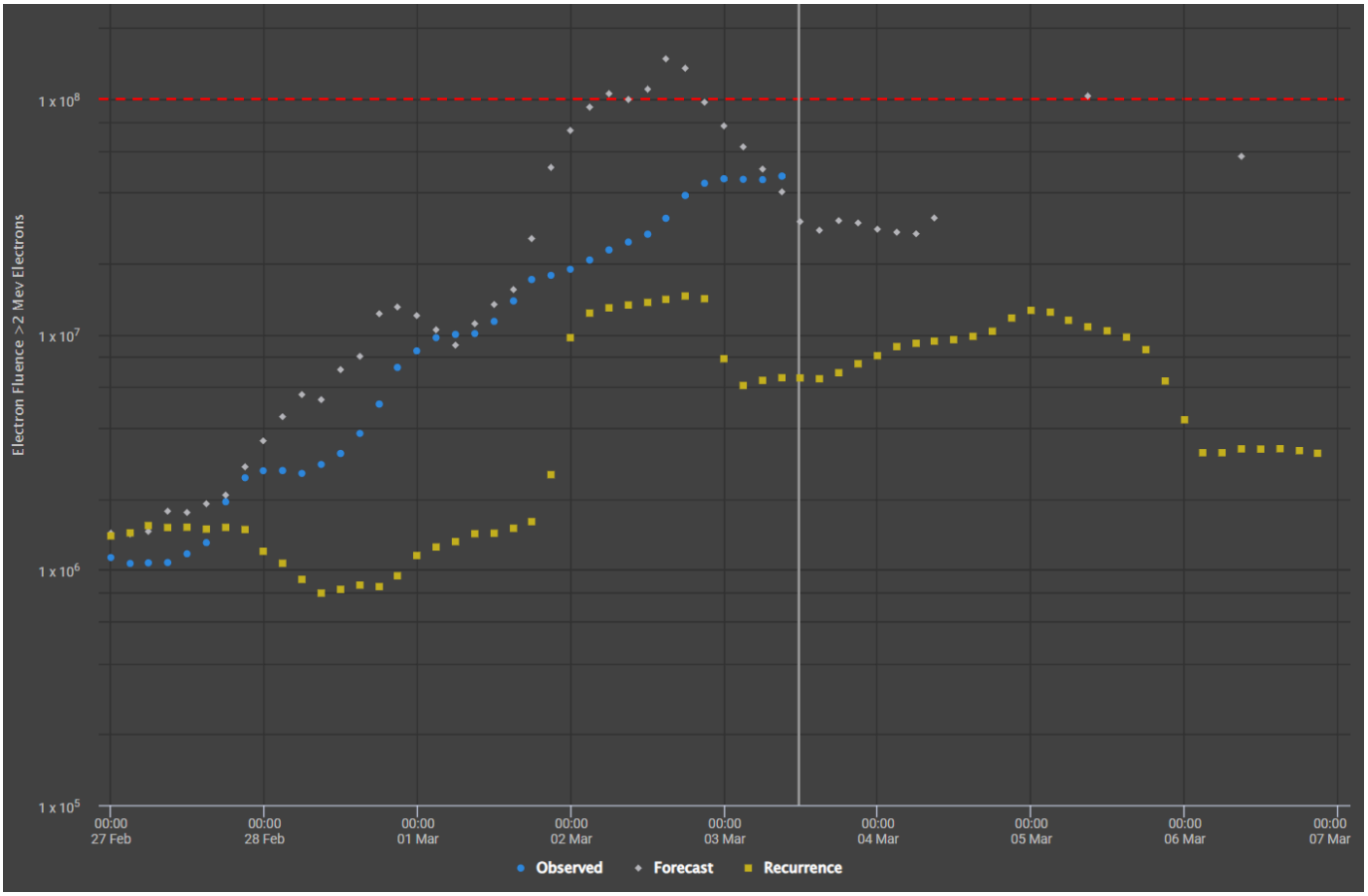
Figure 5: MOSWOC REFM model showing electron fluence rise over recent days, along with forecast active levels.



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